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(Non-provisional Application)

AN IMPROVED SKI BINDING

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Description

TITLE

An Improved Ski Binding

BACKGROUND OF THE INVENTION

1.Field of the invention

The present invention relates to a safety binding for interfacing a ski boot to a ski or skiboard. A skiboard is defined as a ski with an overall length of 100 cm or less.

2.Discussion of the Related Art

Skiboards have been offered for sale with non-releasable bindings for several years. Non-releasable bindings were justified for use on skis under 100cm due to the reasonable belief that the limited length of the ski would limit loads on the skier's leg to safe levels. Recently available statistics now show that injuries to skiboarders, although not largely disproportionate to the overall injury rate among skiers, show a disproportionate number of the injuries to the lower leg. These injuries include spiral fractures of the tibia, a very common injury to skiers before the availability of well engineered releasable safety bindings for skis in the 1970's and 1980's. The development of releasable safety bindings for skis has practically eliminated lower leg fractures and therefore

appropriately designed releasable safety bindings can reasonably be expected to practically eliminate the lower leg fractures seen among skiboarders.

Conventional safety bindings for skis are not suitable for use on ski boards or other short skis for a variety of reasons:

a. They are generally too long. The release mechanism is generally located in front of the toe and behind the heel of the boot. The running length of a skiboard is typically 65 cm. A boot/binding system is typically 60 cm.

b. The thickness required by the skiboard design will not allow enough thickness for the typical attachment screws that hold the toe piece and heel pieces to the ski.

c. The desirable flexibility of the extremities of the skiboard would compromise the function of conventional bindings that depend on the very stiff and stable platform typical of conventional skis and described by ASTM and ISO standards for compatibility.

d. Skiboards do not and probably cannot be reasonably designed to conform to the ASTM and ISO standards for binding mounting areas on skis. These standards were developed to make ski designs compatible with conventional binding designs.

Furthermore, since the basic configuration of safety bindings was developed in the 70's and 80's, when skiboards and very short adult skis did not exist, there is an opportunity to eliminate some of the design limitations and flaws that have been perpetuated by the various binding manufacturer.

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Current trends in ski design are towards much shorter ski lengths. Even skis used by elite world-class racers are often less than 160cm in length, with running lengths less than 135 cm. The binding mounting area controlled by ASTM and ISO compatibility standards is 60 cm long. That is approximately 45% of the running length of a 160 cm ski. Compromises must be made in order to design these short skis to conform to ASTM and ISO standards intended to assure compatibility with the various bindings on the market. If a binding could be designed to eliminate or reduce the constraints imposed by conventional binding designs then ski design could be advanced to a new performance level. There have in the past been some efforts to create bindings which would not impair the ability of a ski to flex, such as US 5,129,668 (Hecht) and US 5,671,939 (Pineau) both of which describe a system in which a mounting is provided for the ski binding, said mounting creating a raised surface for the binding while allowing the ski to flex to a full arc. These mounting however add to both the cost and the complexity of a binding since an entirely new part is added.

Mounting conventional bindings is a complex procedure that is normally done by certified professionals employed by ski shops and trained by specialists. If a binding could be designed to mount to metal inserts built into a ski in a standard insert pattern with machine screws then this complexity can be eliminated. This is the norm in the snowboard industry where bindings can be simply mounted by the consumer with nothing more than a Phillips screwdriver.

Controlling the effects of boot/binding friction on binding performance is one of the most difficult factors of binding design. Shortcomings in how friction has been dealt with by designers of conventional bindings makes the adjustment of the binding to the boot, and confirmation that such adjustments will produce the desired release characteristics, a very complex task that is normally performed by certified professionals. This is due to the fact that most of the friction between the boot and the binding is not "sensed" by the release mechanism of the binding. Therefore, any variation in frictional forces produces a variation in release torque. The person adjusting the binding must understand this relationship to properly adjust the binding.

If a binding could be designed with a sensing mechanism that senses all the forces between the boot and the binding that result in a torque on the tibia then friction would not have to be controlled within very strict limits. Frictional loads would only have to be held below a value that is in the range of normal friction between a typical shoe sole and the ground since humans have evolved the strength to withstand such forces. All fictional forces not seen by the release mechanism would be contained within the binding mechanism and therefore would be subject to the control of the design engineers and of no concern to the person mounting and adjusting the binding. Boot binding adjustment would not be critical to binding performance and could potentially be undertaken by the consumer.

One solution which has been used in trying to solve this problem in the past are plate bindings. Plate bindings of various types have a plate which is either formed integral with the binding, US4,052,086 (Eckhart), US5,240,275 (Jungkind), US5,044,657 (Freisinger et al.), US4,893,831 (Pascal et al.), US4,892,326

(Svoboda et al.), US4,314,714 (Gertsch), and US4,073,509 (Gertsch) being examples of this type; or having a detachable plate which is fastened to the ski boot, as in US5,145,202 (Miller), US5,044,654 (Meyer), US4,395,055 (Teague, Jr.), US4,185,851 and US3,944,237. In both of these types of binding the designer attempts to take the unknown friction between the boot and the binding out of the picture by having the boot be fixed to a plate and leaving only a known friction between the plate and the binding.

Conventional bindings release by sensing a lateral force at the toe of the boot and cannot differentiate between loads at the tip of the ski and loads at the tail of the ski that produce the same torque about the tibial axis. For example, a release caused by a force on the lateral (outside) edge of the ski 70 cm in front of the tibial axis will subject the tibia and connective tissues to same torque but opposite shear load than if the same load where applied to the medial (inside) edge 70 cm behind the tibial axis. It is believed by many knowledgeable in the art of ski binding design and ski injury analysis that Anterior Cruciate Ligament (ACL) injuries to the knee are often caused by a load to the medial (inside) edge of the tail of the ski. This kind of load causes an abduction and inward twisting of the lower leg. If a binding could be designed that could differentiate between loads applied at the tip of the ski, outward twisting loads applied at the lateral side of the ski tail and inward twisting loads applied at the medial side the ski tail it may have the potential to afford skiers significant additional protection against ACL injuries that conventional bindings cannot provide.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved ski binding that addresses, but is not limited to addressing the above issues, and to provide a safety binding for interfacing a ski boot to a ski or skiboard. As previously explained, a skiboard is defined as a ski with an overall length of 100 cm or less. The safety binding in question having a base plate which in the preferred embodiment of the invention is shorter than a conventional ski binding and which can be mounted on standard inserts built into the ski. The connection with the ski itself is located centrally on the binding and once mounted the base plate is raised slightly above the surface of the ski. Thus the binding does not require the same flat surface area as a conventional binding, and the normal flexibility of the ski is not hindered by the binding.

Mounted on the base plate is a top plate which is pivotable in a lateral direction. The top plate is biased towards a predetermined position. Mounted on the top plate are means for holding a ski boot in place. The mounting is such that any pivoting movement of the top plate will result in at least one of the holding means being pivoted or otherwise moved. This pivoting or movement will cause the holding means to release. The heel is also designed to release with conventional means. While in the binding, the boot rests on a toe pad and a heel pad. These pads are connected to the top plate such that any torque on the boot is transferred through these pads to the top plate. If the force is sufficient to overcome the bias on the top plate then it pivots, and the boot is released. After the boot is released, the bias on the top plate returns it to its normal state. The heel portion of the binding can also

be outfitted with a conventional ski brake to prevent the ski from sliding away in the case of a release.

In accordance a first (Figure 3) illustrative embodiment of the invention, a ski binding is provided for securing a ski boot to a ski. The binding comprises a base, two elongated plates pivotably attached to the base near its centroid, a toe cup and a heel cup rotatably attached to the elongated plates. The two elongated plates, the toe cup, and the heel cup are pivotably attached to each other in a parallelogram arrangement. The elongated plates are biased by a spring and cam to have their longitudinal axis aligned with the longitudinal axis of the ski. The toe and heel cups constrain the ski boot substantially parallel to the elongated plates. Any torque applied to the ski boot is transmitted through the toe and heel cups to the elongated plates. At a prescribed load, the elongated plates rotate from their biased positions and the parallelogram arrangement skews causing the toe and heel cups to rotate such that the boot is free to release from the binding.

In a accordance with a second (Figure 4) illustrative embodiment of the invention, a ski binding is provided that comprises a base, a rigid plate pivotably attached to the base near its centroid, a toe and heel cup pivotably attached near the extremities of the rigid plate, one or more connecting rods pivotably attached to the base and pivotably attached to a separate point on the toe and/or heel cup. The rigid plate is biased by a spring such that its longitudinal axis is aligned with the longitudinal axis of the ski. The toe and heel cups constrain the ski boot substantially parallel to the rigid plate. Any torque applied to the ski boot is transmitted through the toe and heel cups to the rigid plate. At a prescribed load

the rigid plate rotates from its biased position and the connecting rod(s) cause the toe and heel cups to rotate such that the boot is free to release from the binding.

In accordance with a third illustrative embodiment of the invention, a ski binding is provided that comprises a base, a rigid plate pivotably attached to the base near its centroid, a toe and heel cup slidably attached near the extremities of the rigid plate, one or more connecting rods attached at one end to the toe and/or heel cup(s) and at the other end connected or in contact with a link or cam surface on the base so that any rotational moment, from the boot through the toe and heel cups, that overcomes the biased alignment of the rigid plate causes the connecting rod(s) to translate the toe and/or heel cup(s) away from the boot in such a way that the boot free to release from the binding.

In accordance with a fourth (Figure 5) illustrative embodiment of the invention, a ski binding is provided that comprises an elongated base plate, an elongated rigid plate pivotably attached to the base near its centroid, a toe and/or heel cup pivotably attached to both the elongated base plate and the pivotable rigid plate at separated points. Any rotational moment applied to the boot and transmitted to the toe and heel cups that overcomes the biased alignment of the pivotable plate and causes the pivotable plate to move relative to the base plate will cause the toe and/or heel cup(s) to rotate or translate in such a way that the boot is free to release from the binding. The biased alignment of the pivotable plate is maintained by a double spring/cam arrangement having two springs which are attached to pins which connect with four distinct cam surfaces. The cam surfaces are attached to the pivoting plate in opposing positions. By altering the cam surfaces it is possible to have a different bias for the directions in which the pivoting plate can pivot.

A BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and appreciated from following the description of illustrative embodiments thereof, and accompanying drawings, in which:

Figure 1 is a perspective view of one embodiment of the invention with a boot, mounted on a typical skiboard.

Figure 1A is a perspective view of the embodiment shown in figure 1, without the boot.

Figure 2 is a side view of the embodiment shown in figure 1.

Figure 3 is a perspective view of a second embodiment of the invention from which certain components have been removed.

Figure 4 is a perspective cross-sectional view of a third embodiment of the invention from which certain components have been removed.

Figure 5 is a perspective cross-sectional view the embodiment of the invention described in figure 1.

Figure 5A is a closeup of the biasing means shown in figure 5.

Figure 5B is a perspective view of the embodiment of the invention described in figure 1 from which certain components have been removed.

Figure 6 is a top view of the embodiment shown in figure 1 with some components removed from view, showing the elongated base plate and spring biasing means.

Figure 6A is a top view of the embodiment shown in figure 1A.

Figure 7 is a top view of the embodiment show in figure 1 in an open position, without the boot.

Figure 8 is a top view of the embodiment shown in figure 1 in an open position with a ski boot superimposed.

Figure 9 is an exploded view of the embodiment shown in figure 1.

Figure 10 is an exploded view of the embodiment shown in figure 4.

Figure 11 is a perspective view of the embodiment shown in figure 4.

DESCRIPTION OF PREFERRED EMBODIMENTS

The invention will be better understood in the following detailed description of the preferred embodiments with reference to the drawings.

Fig. 1 and 2 show the preferred embodiment of the invention. In this embodiment the binding 100 is mounted on a ski 10. The binding is separated from the ski by a bottom pad 110, which allows the ski to flex and makes sure that the ski is not harmed by the binding when flexing. Resting on the bottom pad 110 is a static base plate 120. The central area of the static base plate 120, contains the biasing means 180 (shown in figure 5 and 6), which hold top plate 130 in its normal position. Top plate 130 is mounted on top of the static base plate 120 in such a way that the top plate 130 can pivot laterally around the biasing means 180. Mounted on the top plate 130 are the heel holding cup 150 and the toe holding cup 140. These cups work to hold a boot (shown schematically as 60) to the binding. The heel cup 150 is also fitted with conventional boot release means 160. The boot 60 rests on the heel pad 155, and the toe pad 145. These pads are mounted on the top plate 130 such that any torque applied to the boot 60 is transmitted to the top plate 130. The heel pad 155, is fitted with a conventional ski brake 170 which prevents the ski from sliding away in the case of a release of the boot 60.

As seen in **Fig 2,** the binding 100 is fastened to the ski 10 by screws 20 in a central location. The binding 100 is separated from the ski 10 by the bottom pad 110, which tapers off towards the extremities of the binding to create spaces 15 or alternatively is sufficiently soft towards the extremities to deflect or compress to create spaces. The existence of spaces 15 allows for the ski to flex without being hindered by the binding.

Fig 3. shows another embodiment of the invention. In this embodiment the invention has a base pad 210 which attaches to the ski (not shown). Mounted on top of the base pad 210 are two elongated plates 222 and 224 which can pivot

laterally about their centroid 221 and 223. The plates 222 and 224 are biased towards being aligned with the ski, by the biasing mechanism 280. This mechanism is adjustable to give a greater or lesser bias by wheel 282. Mounted on top of the plates 222 and 224 are the toe cup 240 and the heel cup 250. In this embodiment the toe cup 240 and the heel cup 250 are integrally formed with a toe pad 245 and a heel pad 255. Each of the toe pad 245 and the heel pad 255 are pivotally connected to both elongated plates 222 and 224 at points 246, 247, 256 and 257. A boot (not shown) rests on the toe pad 245 and the heel pad 255, such that torsional forces (about a vertical axis) on the boot cause frictional and/or impingment forces to be applied by the boot to the toe pad 245 and to the heel pad 255. These forces are transferred to the plates 222 and 224. If the force is sufficiently large to overcome the bias created by the biasing mechanism 280, then the plates 222 and 224 will pivot laterally, thus being displaced with respect to each other. This displacement causes the toe cup 245 and the heel cup 255 to be pivoted thereby releasing their hold on a boot.

Fig 4. shows still another embodiment of the invention. In this embodiment we have a base pad 310, on top of which is pivotably mounted a top plate 23. A spring (not shown) gives the top plate 310 a bias towards being aligned with the ski (not shown). Mounted over the top plate 310 are toe cup 340 and heel cup 350, both of which are pivotable about a vertical axis. The toe cup and heel cup are pivotably attached to the top plate 330 such that any torsional force about a vertical axis affecting a boot held between the toe cup 340 and the heel cup 350 will cause the top plate 330 to pivot about its centroid 335. The toe cup 340 and the heel cup 350 are further attached to connecting rods 320 which are situated within the top plate 330. If a torsional force is created on a boot secured in the binding, is great enough

to overcome the bias in the top plate 330, then the top plate 330 will pivot laterally causing the connecting rods 320 to move and thereby rotating the toe cup 340 and the heel cup 350 to a release position. After the boot has been released the bias in the top plate will return the top plate to is neutral position.

Figures 5, 5A, 5B, and 6 clearly show the insides of the biasing means 180, which is responsible for giving the top plate 130 its predetermined bias. The biasing means 180, consists of and adjustor 182, which can be used to adjust the force needed to overcome the bias, and two springs 184 and 186 which are connected to the top plate 130 to give it its bias. These figures also show the fastening means 142 and 152 by which the heel pad 145 and the toe pad 155 are connected to the top plate 130. It is through these that the torsional force on the boot is transferred to the top plate 130. Also shown are the connecting means 144 and 154 which hold the toe cup 140 and the heel cup 150 to the base plate. It is through these two different connections that the toe cup 140 and the heel cup 150 are caused to pivot or translate during release. We also see the bias pins 183 and 185 which are connected to the springs 184 and 186 and the top plate by the way of cam surfaces 187, 188, 189, and 190 which are in contact with front cam roller 191 and rear cam roller 192.

By properly designing the cam surfaces 187, 188, 189, and 190 it is possible to obtain a ski binding in which the ski boot will be released more easily if a load is applied to the medial (inside) edge of the tail of the ski than if a similar load is applied to the lateral (outside) edge of the front of the ski.

Fig 7. shows and top view of the preferred embodiment of the invention in an open configuration. In this figure we can see how a twisting load on the forebody of the ski affects the top plate 130. The top plate 130 pivots in a counterclockwise direction about the rear cam roller 192, the toe cup 140 and the heel cup 150 are pivoted in a clockwise direction about connecting means 142 and 152, thereby releasing the boot. Alternatively, if the twisting load is applied to the tail of the ski the top plate pivots about the front cam roller 191.

Fig 8. shows the same configuration as **Fig 7.** only this time with a boot 60 superimposed to show how the toe cup 140 and the heel cup 150 release the boot as they pivot.

It will be apparent to those skilled in the art that several modifications and variations not mentioned exists. Accordingly the previous descriptions are only meant for the purposes of illustration, and are not meant to limit the scope of the invention.